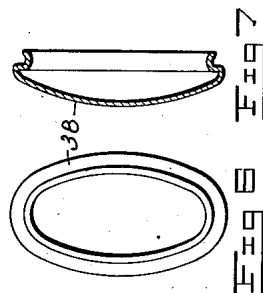
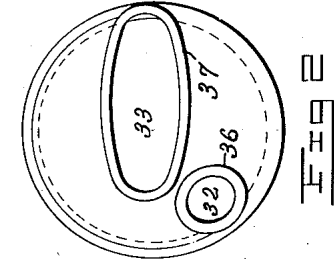
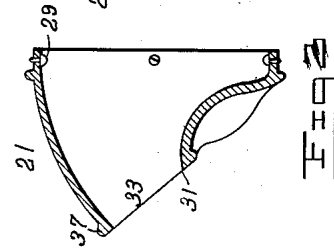
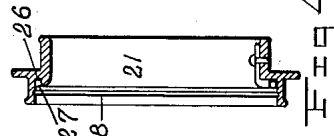
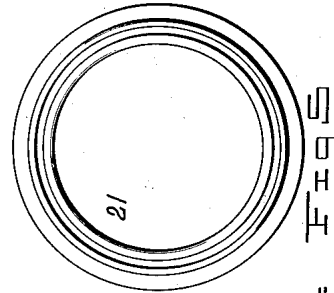
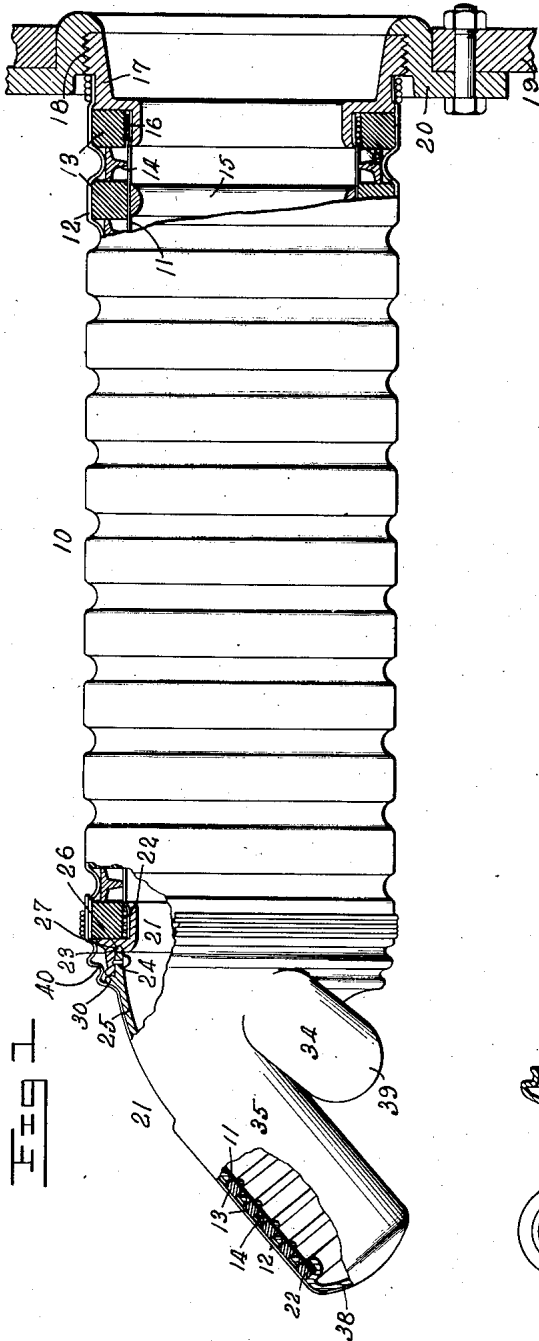


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 FLEXIBLE ARM AND MITTEN.  
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# UNITED STATES PATENT OFFICE.

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FLEXIBLE ARM AND MITTEN.

1,010 558.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, CHARLES WILLIAMSON, a citizen of the United States, residing at Norfolk, in the county of Norfolk and State of Virginia, have invented new and useful Improvements in Flexible Arms and Mittens, of which the following is a specification.

My invention relates to a flexible arm and mitten for submarine work. While my invention is especially intended for use with caissons, it may readily be used in other connections, as for instance with divers' suits, submarine boats, etc.

The object of my invention is to enable work to be done by hand outside of the body structure in which the workman is located. In order that such work may be done with facility it is necessary that the extended branch of the structure from which the work is to be done should possess several important qualifications. Chief among these are flexibility, easy manipulation and durability. In working out my invention my object has been to produce a device in which these qualifications are embodied.

My improved device, in the embodiment of the invention which I shall describe, takes the form of a flexible tube connected to the body structure from which the work is to be done, and which accommodates the arm of the workman. This tube I call the main body of my device. Attached to the end of this tube which is of suitable length is a mitten for accommodating the hand of the workman. This mitten is formed with a rigid palm and flexible thumb and finger portions, the entire mitten being capable of being twisted with respect to the main body or tube attached to the body structure. As the tube or main body is flexible the device may be moved within a wide range, and as the mitten portion is capable of being twisted, and the finger and thumb portions are flexible, the hand of the workman may be turned through a wide range to grasp any object within his reach. To further increase the ease of manipulation of my device I so proportion its weight that it is equal to the weight of the water displaced by the device. This enables the operator to move it within a wide range with all ease, it being necessary to move no weight but only to

overcome the slight elastic resistance due to the flexibility of the device.

The construction of the flexible members of my device is composite, they being formed of a number of related parts so shaped and made of such material as will conduce to greatest flexibility. Likewise the juncture of the mitten with the main body of my device is formed to secure an easy turning movement.

The details of these structures and the advantages of my improved device will be apparent from a consideration of the following description taken in connection with the accompanying drawings in which,—

Figure 1 is a side elevation of my device attached to a body structure, certain of its parts being shown in section. Figs. 2 and 3 are end and sectional side elevations of the palm portion of the mitten. Figs. 4 and 5 are plan and section respectively of an end member used in connection with the palm portion of the mitten, and Figs. 6 and 7 are plan and section respectively of a metallic end cap used on the thumb and finger portions of the mitten.

Referring to the drawings, 10 represents the main body portion of my device which accommodates the arm of the workman. This body portion is tubular and is formed of two flexible water proof casings 11 and 12 spaced apart by flexible members 13 of rubber or other suitable material. Between the flexible members 13 are interposed rigid spacing members 14. These members are preferably of metal and of the form shown in section in Fig. 1. It will be noted that this section is in effect triangular, the rings bearing at three points, each edge contacting with an adjacent flexible member 13, and its inner portion contacting with the interior casing 11. The rings or members 14 are of less diameter than the members 13, and the outer casing 12 is corrugated or ribbed, the depressions of the corrugations fitting between the supporting members 13. Inside of the inner casing and within the flexible supporting members 13 are rigid rib members 15 of metal. These rib members are located one within each supporting member 13, and are secured in position in any suitable manner as by banding or gluing. Preferably they are semi-circular in cross

section, thus presenting smooth surfaces to the hand, and forming with the inner casing 11 an interior free from sharp corners which might hurt the hand.

5 At one end of the main body 10 the inner casing 11 is bound down by strands 16 to the smaller flange of a stepped collar 17, the smaller flange constituting the lower step. This flange takes the place of an  
10 endmost rib 15. As in the case of the ribs 15, a flexible supporting member 13 is superposed upon the flange outside of the inner wall. The exterior wall is passed over the member 13 and is bound down to make  
15 a water tight joint in the groove in the upper step of the collar 17. On its end surface this collar is provided with screw threads 18 whereby the main body may be attached to a body structure. In the drawing, 19 represents a body structure, and it  
20 has bolted to it a flange 20 into which the end member 17 is screw-threaded. On its opposite end the main body has attached a branch member in the shape of a mitten.  
25 An end member 21 somewhat similar to the end member 17 is similarly attached to the inner wall 11. Instead of being attached directly to the end member 21 the outer casing 12 is bound down over the flexible supporting member 13 above the binding  
30 strands 22.

The outer end of the member 21 has formed in it a socket 23 for receiving the end 24 of the rigid palm portion 25 of the  
35 mitten. At the foot of the socket 23 is formed a race-way 26 accommodating balls 27 against which the end 24 of the rigid palm bears. An interior groove 28 is also formed in the socket (see Fig. 4), and retaining screws 29 are threaded through the  
40 end 24 of the palm member and enter the groove. These screws hold the palm portion in the socket and at the same time permit relative rotative movement of the palm  
45 portion and the main body of the device. A shoulder 30 on the palm portion bears against the outer end of member 21 and coöperates with the ball bearing at the bottom of the socket.

50 The palm portion 25 is preferably formed of metal and is made of such shape as to accommodate the palm of the hand. While its end 24 is circular in order to properly fit within the socket 23 its opposite end 31  
55 is irregular in shape and is provided with two openings 32 and 33, the one being circular to accommodate the thumb and the other being elliptical or oblong to accommodate the fingers. Flexible thumb and finger  
60 members 34 and 35 whose structure is essentially similar to that of the main body 10 of the device are secured to the openings 32 and 33 respectively. The inner water proof casing 11 of these members extends over

flanges 36 and 37 (see Fig. 1) and is bound 65 to the palm member 25 to form a water tight joint as the inner wall 11 of the main body 10 is bound to the members 17 and 21. Likewise the opposite ends of the inner  
70 walls 11 are bound to end members 38 and 39, these end members of the thumb and finger portions being made in the form of caps (see Figs. 6 and 7), which close the ends of the members. The outer casing 12  
75 instead of being separately bound at each end for each of the thumb and finger portions of the mitten, is in the form of a glove which covers the entire mitten portion of the device, being bound down to the supporting member 13 adjacent the end mem- 80  
ber 21 along with the outer casing 12 of the main body 10, the ends of the two outer casings being overlapped as clearly shown in Fig. 1. Adjacent the joint, the mitten is formed with a number of folds 40 which 85  
make it loose at this point and enable the mitten portion to be turned without binding. While I have formed the outer casing 12 of the mitten portion of my device in the shape of a glove as described, I may 90  
of course form each portion of the outer casing separately as in the case of the main body 10.

Constructed as described, my flexible arm and mitten is complete and when attached 95 as shown in Fig. 1 to a body structure for submarine use may be used with facility. It normally occupies the position shown, the weight of the device having been made equal to the weight of the water displaced 100  
by it. This being the case there is no tendency for it to move up or down, and it may be moved with minimum effort to any position desired. The particular structure of the flexible members greatly increases the 105  
flexibility of the device as compared with devices heretofore in use, while at the same time it is very strong, being capable of resisting very high pressures. In addition to enhancing the flexibility, the ribbing of the 110  
outer casing 12 enables it to be most readily accommodated and supported against external pressure by the members 13 and 14, the casing 12 fitting close to their outer periph- 115  
eries. The members 13 being flexible and elastic permit relative movement between the members 14, while they themselves are supported against external pressure by the interior ribs 15. The provision of two water proof casings gives double the security 120  
against leaking.

While I have described the best form of my invention now known to me, it is of course evident that many modifications may be made in the specific structure without departing from the generic spirit of my invention. I desire to cover all such modifications in the annexed claims. 125

What I claim is,—

1. A flexible member for accommodating the arm of a submarine worker comprising a flexible main body portion, a water proof casing for said portion, a rigid palm portion and flexible thumb and finger portions, and a separate water proof casing covering said palm, thumb and finger portions. 5
2. In a flexible member for accommodating the arm of a submarine worker, a flexible main body portion, and a rigid palm portion, said palm portion being capable of rotative movement with respect to said main body portion. 10
3. In a flexible member for accommodating the arm of a submarine worker, a flexible main body portion, a socket in one end of said portion, and a rigid palm portion fitting in said socket. 15
4. In a flexible member for accommodating the arm of a submarine worker, a flexible main body portion, a rigid palm portion, and a tongue and groove connection between said portions. 20
5. In a flexible member for accommodating the arm of a submarine worker, a flexible main body portion, a rigid palm portion, and a ball bearing between said portions. 25
6. In a flexible member for submarine work, a main body portion, a branch portion rotatively coupled thereto, and a water proof casing for said members, said casing being circumferentially flexible at the jointure of said portions. 30
7. A flexible member for submarine work comprising a main body portion and a branch portion rotatively coupled thereto, a casing for said members, and a plurality of folds in said casing at the jointure of said portions. 35
8. In a flexible member for submarine work, an arm portion, a casing therefor, a hand portion, and a mitten casing therefor, said casings overlapping and being bound with common means to form a water tight joint. 40
9. A flexible member for submarine work comprising a waterproof casing, and means for supporting said casing against external pressure comprising a plurality of supporting ribs laterally spaced apart, and means other than said casing for maintaining said ribs in spaced relation to each other. 45
10. A flexible member for submarine work comprising a plurality of flexible rings placed side by side, and a water proof casing supported against external pressure by said rings. 50
11. A flexible member for submarine work comprising a plurality of flexible rib members, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 55
12. A flexible member for submarine work comprising a plurality of rubber rib members, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 65
13. A flexible member for submarine work, comprising a plurality of flexible rib members, a plurality of interposed metallic spacing members, and a water proof casing supported against external pressure by said members. 70
14. A flexible member for submarine work comprising a plurality of flexible rib members of a certain outside diameter, a plurality of interposed spacing members of a certain different outside diameter, and a water proof casing supported against external pressure by said members. 75
15. A flexible member for submarine work comprising a plurality of flexible rib members of a certain outside diameter, a plurality of interposed spacing members of a certain different outside diameter, and a ribbed water proof casing supported against external pressure by said members, the ribs of said casing fitting between said spacing members. 80
16. A flexible member for submarine work comprising a plurality of flexible rib members of a certain outside diameter, a plurality of interposed spacing members of a certain different outside diameter, and a corrugated water proof casing supported against external pressure by said members, the depressions of said corrugations fitting between said first named members. 85
17. A flexible member for submarine work comprising a plurality of rubber rib members, a plurality of interposed metallic spacing members, and a water proof casing supported against external pressure by said members. 90
18. A flexible member for submarine work comprising a plurality of rectangular rib members, a plurality of interposed triangular spacing members, and a water proof casing supported against external pressure by said members. 95
19. A flexible member for submarine work comprising a plurality of spaced supporting members, a plurality of flexible members superposed thereover, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 100
20. A flexible member for submarine work comprising a plurality of spaced metallic supporting members, a plurality of rubber members superposed thereover, a plurality of interposed metallic spacing members, and a water proof casing supported against external pressure by said members. 105
21. In a flexible member for submarine work comprising a plurality of spaced supporting members, a plurality of flexible members superposed thereover, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 110
22. A flexible member for submarine work comprising a plurality of spaced supporting members, a plurality of flexible members superposed thereover, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 115
23. A flexible member for submarine work comprising a plurality of spaced supporting members, a plurality of flexible members superposed thereover, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 120
24. A flexible member for submarine work comprising a plurality of spaced supporting members, a plurality of flexible members superposed thereover, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members. 125

- work, a plurality of spaced supporting members, an interior casing supported thereby, a plurality of flexible members superposed on said supporting members exterior to said casing, a plurality of interposed spacing members, and a water proof casing supported against external pressure by said members.
22. A flexible member for submarine work comprising a plurality of spaced supporting members of approximately semi-circular cross section, a water proof interior casing supported thereby, a plurality of flexible members superposed on said supporting members exterior to said casing, a plurality of interposed spacing members, and an exterior water proof casing supported against external pressure by said members.
23. In a flexible member for submarine work, a casing and supporting ribs therefor, said supporting ribs being approximately semi-circular in cross section.
24. A flexible member for submarine work comprising an interior casing and an exterior casing, means spacing said casings apart, and a plurality of spaced supporting members on the inside of said interior casing.
25. In a flexible device for submarine work having two water proof casings, an end member for said device provided with two peripheral grooves, one for accommodating an end of one casing and one for accommodating the end of the other casing, and means for binding the casing ends in the grooves to form water tight joints.
26. In a device for submarine work having two water proof casings, an end member for said device comprising a stepped collar, a groove on one step for accommodating the end of one casing, and a groove on the other step for accommodating the end of the other casing.
27. In a device for submarine work having two water proof casings, an end member which makes a water tight joint with each casing.
28. In a device for submarine work having two water proof casings, an end member which makes a water tight joint with each casing, and means on said member for attaching said device to a body structure.
29. A flexible member for submarine work, comprising a casing, and a plurality of supporting ribs spaced apart, the endmost of said ribs making a water tight joint with the casing, and being provided with means for coupling said member to another member.
30. A flexible member for submarine work comprising a flexible casing, and a metallic end cap secured to said casing.
31. A flexible member for submarine work comprising a plurality of rings placed side by side, a water proof casing supported against external pressure by said rings, and an end member comprising a metallic cap provided with a groove in which said water proof casing is secured.
32. In combination a submarine body structure, an opening in said structure, a screw-threaded flange bolted in said opening, and a flexible member screw-threaded thereto.
33. A flexible member for submarine work comprising two connected portions movable with respect to each other, means connecting said portions together, and a thrust bearing between said members where by the thrust of the one portion is taken up by the other portion.
34. A flexible branch member for use with a submarine body structure comprising two connected portions, means coupling said portions together, and a ball bearing between said portions.
35. A flexible member for use in connection with a submarine body structure comprising two connected portions, and a tongue and groove connection between said portions.
36. A flexible member for use with a submarine body structure comprising two connected portions, one of said portions fitting into a socket carried by the other of said portions, and means other than the said socket for connecting said portions together.
37. A flexible arm and mitten for submarine work comprising flexible arm and thumb and finger portions, said thumb and finger portions terminating in metallic end caps.
38. A flexible arm and mitten for submarine work comprising flexible arm and thumb and finger portions, said thumb and finger portions terminating in metallic end caps, and a water proof casing covering said end caps.
39. A flexible member for submarine work comprising interior and exterior casings, said interior casing being provided with and terminating in a metallic end cap, and said exterior casing covering said interior casing and end cap.
40. A flexible member for submarine work comprising a flexible arm portion, a rigid palm portion, an elongate aperture therein for the fingers, and a flexible finger member attached to said rigid palm.
41. A flexible arm and mitten for submarine work comprising a flexible main body portion, a rigid palm portion, an elongated aperture for the fingers in said palm portion, a flange on said palm surrounding said aperture, and a flexible finger member secured over said flange.
42. A flexible member for submarine work

comprising a flexible arm portion, a rigid  
palm portion, an elongated aperture there-  
in for the fingers, a flexible finger member  
attached to said rigid palm and communi-  
5 cating with said aperture, a circular open-  
ing for the thumb, and a flexible thumb  
member also attached to said palm and com-  
municating with said circular opening.

In testimony whereof I have hereunto set  
my hand in presence of two subscribing 10  
witnesses.

CHARLES WILLIAMSON.

Witnesses:

J. F. DRUMMOND,  
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